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STATIONARY SOURCE CONTROL COSTS FOR THE CALIFORNIA FEDERAL IMPLEMENTATION PLANS FOR ATTAINMENT OF THE OZONE NATIONAL AMBIENT AIR QUALITY STANDARD

Final Draft

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ACRONYMS AND ABBREVIATIONS

CAA	Clean Air Act
CARB	California Air Resources Board
FGR	Flue Gas Recirculation
FIP	Federal Implementation Plan
IC	Internal Combustion
ICI	Institutional, Commercial, and Industrial
LNB	Low-NO_x Burners
mmBtu	Million British Thermal Units
MW	Megawatt
NAAQS	National Ambient Air Quality Standard
NMOC	Nonmethane Organic Compounds
NO_x	Nitrogen Oxides
NSCR	Nonselective Catalytic Reduction
ppm	parts per million
RACT	Reasonably Available Control Technology
RECLAIM	Regional Clean Air Incentives Market
SCAQMD	South Coast Air Quality Management District
SCR	Selective Catalytic Reduction
SIP	State Implementation Plan
SMAQMD	Sacramento Metropolitan Air Quality Management District
SNCR	Selective Noncatalytic Reduction
tpd	tons per day
tpy	tons per year
TSD	Technical Support Document
VOC	Volatile Organic Compounds

CHAPTER 1.0
INTRODUCTION

The U.S. Environmental Projection Agency (EPA) is under court order to develop Federal Implementation Plans (FIPs) for the Sacramento and Ventura ozone nonattainment areas, and the South Coast ozone and carbon monoxide (CO) nonattainment areas. The Sacramento area includes all of Sacramento and Yolo Counties and portions of El Dorado, Placer, Solano, and Sutter Counties. The Ventura area includes all of Ventura County. The South Coast area includes all of Orange County and portions of Los Angeles, San Bernardino, and Riverside Counties.

This report documents the control costs associated with the stationary source control measures included in the FIPs for each of the nonattainment areas. Each nonattainment area will be regulated with State implementation plan measures as well – these are not included in this report. The control costs presented here are annual costs incurred in the attainment year. The attainment years analyzed were: 2005 for Sacramento and Ventura, and 2010 for South Coast.

Chapter 2 of this report presents costs associated with the stationary source volatile organic compound (VOC) control measures. Chapter 3 presents costs associated with the stationary source nitrogen oxide (NO_x) control measures. Chapter 4 presents the emission reductions associated with each FIP control measure as well as the reductions for recently approved SIP measures which could not previously be credited toward attainment. Chapter 5 lists the references used in preparing this report.

The Office of Mobile Sources has estimated the control costs associated with the mobile source control measures in the FIP. These cost estimates are available in a separate document entitled, "Control Cost Document for Mobile Source Control Measures for the California FIP" (EPA, 1995).

CHAPTER 2.0
STATIONARY SOURCE VOC CONTROL MEASURES

This chapter presents the control cost estimates for the stationary source VOC control measures. These measures include source-specific control measures (e.g., wood products coating) and source-specific reasonably available control technology (RACT) rules. This chapter also presents costs for controlling South Coast VOC emissions under Section 182(e)(5) of the Clean Air Act (CAA) and stationary source declining cap control measures for controlling South Coast VOC and NO_x emissions.

2.1 STATIONARY SOURCE-SPECIFIC VOC CONTROL MEASURES

The general method employed to estimate the VOC control measure costs was to multiply the estimated emission reduction of each control measure by its associated cost-effectiveness value. Region IX provided the emission reduction estimates for the stationary source control measures (Steckel, 1995a). (Note: The emission reductions used to calculate costs were not adjusted for rule effectiveness because the emission reductions used to generate the cost-effectiveness values were not adjusted for rule effectiveness. See Chapter 4 for a discussion of rule-effectiveness adjustments to the emission reductions.)

A summary of the control costs and emission reductions associated with the source-specific VOC measures is given in Table 2.1. All costs are presented in 1993 dollars. The *Chemical Engineering* Plant Cost Index was used to update costs to 1993 dollars (Rafferty, 1993). The remainder of this chapter presents the basis of the costs for each control measure.

2.1.1 Wood Products Coatings

Costs for this rule were taken from the technical support document (TSD) prepared for the FIP rule. This rule sets emission limits on wood coating products, requires the use of approved application methods and equipment, and allows the option of installing add-on controls to comply with the emission limits. Costs for the rule are based on data developed by the South Coast Air Quality Management District (SCAQMD). The SCAQMD estimated a cost of $18.85 per ton at full implementation assuming the use of reformulated coatings. A cost of $9,630 per ton is estimated for add-on controls, however, facilities are expected to meet the limits through the use of reformulated coatings so the cost for add-on controls is not included in the analysis. The overall control efficiency assumed, also based on the SCAQMD calculations, is 92.8 percent at full implementation (Radian, 1993a).

Table 2.1
Summary of Stationary Source Control Measures

SACRAMENTO Control Measure	VOC Reduction[1] (tpd) 2005	Cost Effectiveness ($/ton) Low	 High[2]	Annual Cost[1] (1000 $) Low	 High[2]
Wood Products	0.4		19		2.8
Auto Refinishing Operations	4.1		7,220		10,804.7
Adhesives & Sealants	1.5	(545)[3]	2,340	(298.4)	1,281.2
Solid Waste Landfills	1.4	14,000	32,000	7,154.0	16,352.0
Solvent Cleaning Operations	4.9		(1,062)		(1,899.4)
Fugitive Emissions					
Refineries, Bulk Plants/Terminals, & Chemical Plants	0.3		1,430		140.9
Pesticides	3.2		7,540		8,806.7
Architectural Coatings	4.3	(8,680)	12,900	(13,623.3)	20,246.6
Gasoline Transfer and Dispensing	0.4		1,775		226.8
Aerosol Coating Products	1.1		10,000		4,015.0
SierraPine	0.4	2,900	4,750	423.4	693.5
Sierra-Pacific[4]	0.6		0		0.0
Reynolds Metal	0.1		0		0.0
Total	23.3				60,670.7

[1] Totals may not equal sums due to rounding.
[2] For control measures without low costs, costs are not high-end estimates.
[3] () denotes cost savings.
[4] This source was formerly known as Michigan-California Lumber in the proposed rule (before acquisition by Sierra-Pacific Industries).

Table 2.1. Summary of Stationary Source Control Measures (cont.)

VENTURA Control Measure	VOC Reduction[1] (tpd) 2005	Cost Effectiveness ($/ton) Low	High[2]	Annual Cost[1] (1000 $) Low	High[2]
Wood Products Coatings	0.2		19		1.4
Solvent Cleaning Operations	1.8		(1,062)[3]		(697.7)
Waste Burning	0.1		0		0.0
Fugitive Emissions					
1. Refineries, Bulk Plants/Terminals, & Chemical Plants	0.1		1,201		54.5
2. Oil Production Facilities	1.1		527		206.9
Pesticides	3.9		7,540		10,733.2
Architectural Coatings	1.4	(8,680)	12,900	(4,435.5)	6,591.9
Gasoline Transfer and Dispensing	0.2		3,105		169.9
Aerosol Coating Products	0.4		10,000		1,460.0
Total	9.2				18,520.1

SOUTH COAST Control Measure	NO_x Reduction[1] (tpd) 2010	VOC Reduction[1] (tpd) 2010	Cost Effectiveness ($/ton) Low	High[2]	Annual Cost[1] (1000 $) Low	High[2]
Waste Burning		0.3		0		0.0
Fugitive Emissions						
1. Refineries, Bulk Plants/Terminals, & Chemical Plants		3.0 - 4.5	697	1,047		1,139.5
2. Oil Production Facilities		0.9		3,562		1,221.9
Pesticides		2.3		7,540		6,329.8
Architectural Coatings		20.8	(8,680)	12,900	(65,898.6)	97,936.8
Gasoline Transfer and Dispensing		5.6		1,508		3,082.4
Aerosol Coating Products		9.2		10,000		33,580.0
VOC Declining Cap		50.0		10,000		182,500.0
NO_x Declining Cap	73.8			9,000		242,433.0
Section 182(e)(5) - VOC		218.0		10,000		795,700.0
Section 182(e)(5) - NO_x	7.0			9,000		22,995.0
Total	80.8	310.1 - 311.6				1,386,918.4

[1] Totals may not equal sums due to rounding.
[2] For control measures without low costs, costs are not high-end estimates.
[3] () denotes cost savings.

Table 2.1. Summary of Stationary Source Control Measures (cont.)

STATEWIDE[1] Control Measure	VOC Reduction[2] (tpd) 2005	2010	Cost Effectiveness ($/ton) Low	High[3]	Annual Cost[2] (1000 $) 2005 Low	2005 High	2010 Low	2010 High[3]
Pesticides	28.0	28.0		7,540		77,058.8		77,058.8
Architectural Coatings	72.0	77.0	(8,680)[4]	12,900	(228,110.4)	339,012.0	(243,951.4)	362,554.5
Aerosol Coating Products	15.0	25.0		10,000		54,750.0		91,250.0
Total	115.0	130.0				470,820.8		530,863.3

[1] Statewide emissions reductions and costs should not be totaled with FIP area numbers because the statewide estimates for these control measures include the emission reductions and costs shown for each FIP area.
[2] Totals may not equal sums due to rounding.
[3] For control measures without low costs, costs are not high-end estimates.
[4] () denotes cost savings.

2.1.2 Automotive Refinishing

The automotive refinishing rule controls emissions through the use of low-VOC coatings, the use of an emission control system as an alternative to low-VOC coatings, and a transfer efficiency requirement equivalent to that achieved through the use of high-volume, low-pressure spray equipment. Emission reductions are based on an effective control efficiency of 89 percent. The cost is based on data developed by the SCAQMD. The SCAQMD estimated a cost of $5,800 per ton based on the control of emissions from all solvent operations. The FIP rule does not regulate all solvent operations and, therefore, the cost-effectiveness will vary from that estimated by SCAQMD. The overall cost effectiveness estimated by Radian for the FIP rule is $7,200 per ton (1990 dollars). Estimated costs are $7,220 per ton in 1993 dollars (Radian, 1993b).

2.1.3 Adhesives and Sealants

The FIP rule controls emissions from the use of industrial and commercial adhesives and sealants by setting VOC limits and prescribing procedures for application, storage, and removal. A 67 percent reduction in emissions from solvent-borne adhesives and sealants is expected. Overall reductions of 60 percent are expected from paper surface coatings, with no reduction from waterborne adhesives. The Ventura County Air Pollution Control District estimated that, depending on the type of adhesive used, the cost effectiveness of switching to low-solvent adhesives ranges from $-545 (savings) to $2,340 per ton. Cost effectiveness for add-on controls would be much higher, ranging from $9,080 to $111,000 per ton ($9,080 to $30,300 for carbon adsorption units and $44,400 to $111,000 for afterburners). Based on a survey of adhesive and sealant users conducted by the Bay Area Air Quality Management District, it is assumed that facilities will comply by using the low solvent adhesives (Shuelick, 1994). All cost estimates are in constant 1993 dollars (Radian, 1993c).

2.1.4 Solid Waste Landfills

The FIP rule controls emissions of nonmethane organic compounds (NMOC) from solid waste disposal sites by processing the landfill gas produced from the decomposition of organic materials. Volatile organic compounds, which are a subset of NMOCs, will therefore also be reduced. The cost effectiveness for the FIP rule is estimated at $10,000 to $23,000 per ton of NMOC reduced. Since VOC emissions are approximately 71 percent of NMOC emissions, this translates to a cost of $14,000 to $32,000 per ton of VOC reduced (Radian, 1993d). A total of 8 landfills in Sacramento county and 1 landfill each in El Dorado and Yolo counties are expected to be affected by this control measure.

2.1.5 Solvent Cleaning Operations

The FIP rule for solvent cleaning operations controls VOC emissions by setting VOC limits and prescribing procedures and requirements for operations. The estimated overall control efficiency of 75 percent is based on the implementation of solvent reformulation and good management practices. Based on information from the SCAQMD, cost effectiveness represents a savings of $1,062/ton of VOC for surface preparation and a cost of $558/ton for equipment cleaning. The overall cost effectiveness depends on the estimated emissions from each of the processes. An overall savings of $1,062/ton is estimated for Ventura. The SCAQMD estimated a cost of $12/ton, although the TSD suggests that there will probably be a cost savings for this rule. Therefore, the cost savings of $1,062/ton was also applied in Sacramento. All costs are in 1993 dollars (Radian, 1993e).

2.1.6 Fugitive Emissions

The FIP contains two rules for controlling fugitive VOC emissions from leaks in valves, compressors, and other components used in the manufacture and transfer of gas, oil, and chemical products. One rule covers refineries, bulk plants and terminals, and chemical plants. The other rule controls fugitive emissions from oil production plants. The cost estimates for each rule are specific to the affected FIP area (Pechan, 1994a). For the rule covering refineries, bulk plants and terminals, and chemical plants, the estimated cost effectiveness is $1,430 per ton of VOC for Sacramento and $1,201 for Ventura. The cost effectiveness of this rule for the South Coast FIP area is estimated to range from $697 per ton of VOC to $1,047. The rule covering oil production plants affects facilities in the Ventura and South Coast FIP areas only ($527 and $3,562 per ton reduction of VOC, respectively).

2.1.7 Pesticides

The FIP rule for this source category is designed to reduce VOC emissions from agricultural and structural pesticide applications. The EPA will use data from pesticide manufacturers to establish VOC content limits for pesticides distributed, applied, or stored in California. Costs of the rule include the VOC content analysis required for pesticide producers (data will be used by EPA to establish VOC content limits), new studies to support reformulation of restricted products, and registration fees. The overall annual cost is estimated at $7,540/ton of VOC reduced (Steckel, 1995b). Since this rule affects entities statewide, both FIP area and statewide annual cost estimates are presented in Table 2.1.

2.1.8 Architectural Coatings

The FIP standards for architectural coatings build upon the standards in the California Air Resources Board's (CARB) model rule. The CARB rule was used as the basis for the cost estimates for this FIP rule. The rule specifies VOC content limits for a variety of different surface coating products. Coatings regulated include primers, sealers, undercoats, clear wood finishes, industrial maintenance coatings, house paints, and specialty coatings. To comply with the standards, manufacturers can replace the noncomplying coatings with coatings that currently comply, or, they have the option to reformulate their coatings to comply with the VOC content limits.

Reformulation may be expensive due to the costs of research and development. If a product is reformulated to use more water, the cost of the coating is reduced since water is less expensive than solvents. Reformulating with water also eliminates the use of expensive pressurized tanks for solvent storage. Therefore, reformulating coating products with water typically results in a net savings. The estimated cost-effectiveness of the CARB surface coating rule ranges from a savings of $8,680 per ton to a cost of $12,900 per ton of VOC removed (1993 dollars). This range is based on specific products. Limited information is currently available on the mix of product categories in the FIP areas so the high and low end product specific costs were used to provide boundaries of the costs.

It should be noted that the cost estimates for the CARB rule do not reflect all of the factors that affect the final cost since many could not easily be quantified. Unquantifiable cost factors which could increase the associated cost for the FIP rule include increased surface preparation costs, research and development costs, changes in work practices and training, changes in product durability, changes in equipment, and the cost of pulling noncomplying coatings off the market. Factors which were not included which may result in additional savings include reduced worker exposure to solvents and reduced clean-up and disposal costs of solvents. As with the pesticides rule, both FIP area and statewide annual cost estimates are provided for this statewide rule.

2.1.9 Gasoline Transfer and Dispensing

This FIP rule reduces VOC emissions from gasoline transfer and dispensing facilities. Gasoline service stations are a source of VOC emissions which are created during vehicle refueling and storage tank working/breathing losses. Although service stations in the FIP areas currently have vapor recovery systems, the rule builds upon current regulations and strengthens and improves existing rules by requiring pressure/vacuum relief valves on open vent pipes and the phasing out of inefficient vapor recovery system components.

Pressure/vacuum relief valves cost less than fifty dollars, are easily installed without underground construction, and improve efficiency of existing vapor recovery systems by 1 to 3 percent. The pressure/vacuum relief valves typically pay for themselves in less than 1 year and result in a cost savings at the gasoline dispensing facility. The FIP rule will also phase out the use of inefficient vapor recovery system components, most of which are periodically replaced due to normal wear and tear. Many of the revisions are based on recent amendments to Bay Area Air Quality Management District Regulation 8, Rule 7 - Gasoline Dispensing Facilities.

The estimated cost effectiveness of this measure is expected to range from $1,508 per ton of VOC reduced in the South Coast to $3,105 in Ventura (EC/R, 1994).

2.1.10 Aerosol Coating Products

This FIP rule, which establishes VOC limits for a variety of product coating types, is based on a draft rule developed by CARB. Affected entities must comply with the first phase of standards by January 1, 1996. A second phase of standards takes effect December 31, 1999. Aerosol coating product manufacturers are expected to develop compliant products through propellant replacement, product reformulation, and improvements in packaging and delivery systems. At full implementation, the rule is estimated to achieve a 60 percent reduction in VOC emissions from 1990 levels. For the first phase of reductions, CARB estimated the cost-effectiveness to range from $8,400 to $9,400 per ton of VOC reduced; cost-effectiveness for phase II is estimated at $10,000 per ton (Ungvarsky, 1994). For the cost analysis, the $10,000 per ton cost estimate is applied to the overall estimated emission reductions at full implementation. Because this rule affects entities statewide, both FIP area and statewide annual cost estimates are provided.

2.1.11 SierraPine

The RACT rule for this plant requires the installation of a VOC collection and control system to control emissions from the process vents and exhausts of wood fiber driers. Cost estimates for SierraPine range from $2,900 to $4,750 per ton of VOC reduced. These low- and high-cost estimates are for carbon adsorption and regenerative thermal oxidation control technologies, respectively (Pechan, 1994b). This plant also has a biomass boiler which is subject to the biomass boiler NO_x rule. Chapter 3 of this report presents the emission reductions and control costs associated with the biomass boiler NO_x rule.

2.1.12 Sierra-Pacific

The RACT rule for this plant establishes a VOC limit for the biomass boiler operated by the plant, which is also subject to the biomass boiler NO_x rule. Emissions of VOC must meet an emission limit of 150 ppm by volume of VOC in the stack exhaust stream. This limit applies only when the production rate exceeds an annual average of 50,000 lbs-steam per hour. The EPA performed a review of VOC and NO_x emissions test data and determined that the plant's boiler is already meeting the VOC limit of the RACT rule, and that the plant could meet the NO_x limit of the biomass boiler rule while meeting the VOC limit. There is no incremental control cost expected from the VOC RACT measure for this plant (Lo, 1993a). Chapter 3 of this report presents the emission reductions and control costs associated with the biomass boiler NO_x rule.

2.1.13 Reynolds Metals

The RACT rule for this plant establishes a VOC content limit for a tab press lubrication line, which the plant is already meeting. Tab press lubricant cannot exceed a VOC content of 5.73 pounds per gallon of lubricant used, less water and exempt compounds, and VOC emissions cannot exceed 1.2×10^{-5} pounds of VOC per tab produced. Because the plant is already meeting the RACT rule limit, no additional costs are associated with this rule (Lo, 1993b). The RACT rule is included in the FIP to comply with EPA policy for controlling major existing stationary sources of VOC emissions in ozone nonattainment areas, and to make the emission reductions required of the plant enforceable.

2.1.14 Waste Burning

This rule complements and expands upon current programs by restricting waste burning to days when ambient ozone concentrations are within acceptable levels. On days predicted to exceed the California ambient air quality standard for ozone (0.09 ppm), all forms of waste burning will be prohibited. The cost for this control measure is assumed to be zero because the effect of this measure is to shift the timing of the waste burning activity. However, there may be indirect costs associated with the rule if personnel scheduled to participate in the burning activity cannot be used elsewhere or due to a delay in the planting of crops.

2.2 STATIONARY SOURCE DECLINING CAP CONTROL MEASURES

For the South Coast FIP, additional VOC and NO_x emission reductions, beyond those that will be achieved by the source-specific and mobile source control measures, are needed to meet the emission reduction target for the attainment demonstration. Both declining cap rules will require stationary sources that emit ≥4 tons per year (of either VOC or NO_x, but not combined) in 2000 to reduce their emissions by 45 percent beginning in 2001 and ending in 2005. The South Coast Air Quality Management District (SCAQMD) has already adopted a NO_x Regional Clean Air Incentives Market (RECLAIM) program and is in the process of developing a VOC RECLAIM program for selected stationary sources. The RECLAIM programs are emissions trading programs which are being designed to lower the cost of compliance that would be associated with command and control measures. The EPA has been working with the SCAQMD in developing its RECLAIM programs to ensure that the programs comply with EPA policies regarding requirements for SIP approval and the national economic incentives rule. The declining cap rules have been included in the FIP as backup rules if the SCAQMD fails to submit SIP approvable RECLAIM programs. The EPA believes that it will be able to approve the RECLAIM programs as a part of the SCAQMD's SIP before the emission control requirements of the declining cap rules take effect in 2001.

Control costs for the declining cap control measures are difficult to quantify. The SCAQMD estimated that the value of NO_x emission reduction credits under its RECLAIM program will approach $9,000 per ton in 2000. This cost-effectiveness value was used to estimate the average costs of the NO_x emission reductions associated with the NO_x declining cap control measure for the South Coast FIP.

A cost effectiveness of $10,000 per ton was used to estimate the costs for the VOC declining cap control measure. The $10,000 per ton value is an estimate based on the following analysis. The SCAQMD plans the use the RECLAIM program to replace command and control measures for selected VOC source categories for which it has developed emission reduction and cost-effectiveness estimates in its Air Quality Management Plan. The command and control measures are designed to achieve additional emission reductions by increasing the stringency of VOC controls for existing SIP rules. The cost-effectiveness values for the command and control measures were combined with the cost-effectiveness values of the source-specific FIP control measures being finalized for the South Coast. Table 2.2 shows the cost-effectiveness values for the control measures. The average cost-effectiveness value for the control measures is about $5,400 per ton, and the median value is about $2,900 per ton of VOC reduction. The cost-effectiveness values range from $100 to $20,000 per ton.

The source-specific VOC control measures for the South Coast will be some of the most stringent control measures ever required for VOC source categories. Because the declining cap control measure will require emission reductions beyond those that will be achieved by the South Coast's and the FIP command and control measures shown in Table 2.2, using the average or median cost-effectiveness value may underestimate the costs associated with the VOC declining cap control measure. The highest cost-effectiveness value (i.e., $20,000 per ton) could have been used; however, it was $7,200 per ton higher than the next highest cost-effectiveness value and may not be representative of the average cost of emission reductions required by the declining cap control measure. Also, the declining cap rules will allow for plant-wide averaging of emissions allowing plants the flexibility in developing a least-cost control strategy. The EPA expects that plant-wide averaging of emissions will result in controls that are less costly than command and control measures. For this analysis, the $10,000 per ton value was selected as an estimate of the average cost-effectiveness of emission reductions. The actual value is unknown.

The cost-effectiveness values for both of the declining cap rules are highly uncertain at this time. If the SCAQMD develops RECLAIM programs that can be approved by EPA as a part of their SIP, then EPA plans to remove the declining cap rules from the FIP. Even if the SCAQMD fails to submit a SIP approvable RECLAIM program for NO_x and/or VOC sources by 2001, EPA may be able to lower the emission reduction requirements of the declining cap rules. The EPA will be tracking emission reductions and improvements in air quality in the South Coast area on an ongoing basis and will be reevaluating the need for requiring a 45 percent emission reduction from each of the declining cap rules. It is possible that emission reductions associated with future rules adopted by the California Air Resources Board (CARB) or the SCAQMD will allow EPA to decrease the emission reduction requirements or eliminate the declining cap rules from the FIP. It is also possible that technological improvements will provide opportunities for lowering the costs of the required emission reductions.

Table 2.2
Cost Effectiveness of South Coast and FIP Source-Specific VOC Control Measures

Source	Control Measure	Cost-Effectiveness Values ($/ton)	VOC Emission Reductions (tons/day)	Total Daily Costs (1993 $)
SC[1]	1. Further Emission Reductions from Paper, Fabric, and Film Coating Operations - Rule 1128	100	6.7	670
SC	2. Further Emission Reductions from Adhesives - Rule 1168	100	16.8	1,680
SC	3. Electronic Components Manufacturing	700	1.1	770
SC	4. Use of Petroleum Solvent in Cold Cleaning	700	24.0	16,800
FIP[2]	5. Fugitive Emissions - Refineries, Bulk Plants and Terminals, and Chemical Plants	1,047[3]	3.0	3,141
FIP	6. Gasoline Transfer and Dispensing	1,508	5.6	8,445
SC	7. Marine and Pleasure Craft Coating Operations - Rules 1106 and 1106.1	1,700	1.5	2,550
FIP	8. Architectural Coatings	2,150[4]	20.8	44,720
FIP	9. Fugitive Emissions - Oil and Gas Production Facilities	3,562	0.9	3,206
SC	10. Further Emission Reductions from Aerospace Assembly and Manufacturing - Rule 1124	5,800	2.4	13,920
FIP	11. Pesticides	7,540	2.3	17,342
SC	12. Further Emission Reductions from Wood Products Coatings - Rule 1136	8,300	2.0	16,600
FIP	13. Aerosol Coating Products	10,000	9.2	92,000
SC	14. Further Control of Emissions from Metal Parts and Products Coating - Rule 1107	10,500	17.5	183,750
SC	15. Further Emission Reductions from Screen Printing Operations - Rule 1130.1	10,700	0.7	7,490
SC	16. Solvent Cleaning Operations - Rule 1171	12,800	1.5	19,200
SC	17. Further Emission Reductions from Motor Vehicle and Mobile Equipment Non-Assembly Line Coating Operations - Rule 1151	20,000	1.1	22,000
	Mean	5,400		
	Median	2,856		

[1] SC = Control measures that the South Coast Air Quality Management District plans to adopt if it does not adopt an emissions trading program (i.e., RECLAIM) for the source categories.
[2] FIP = Control measures included in the Federal Implementation Plan for the South Coast.
[3] Cost-effectiveness values range from $697/ton to $1,047/ton of VOC reduced.
[4] Cost-effectiveness value is the median value of the range. Cost-effectiveness values range from a savings of $8,680/ton to a cost of $12,900/ton of VOC reduced.

The estimated reductions for the declining cap program in 2010 are 50.0 tpd of VOC and 73.8 tpd of NO_x (Steckel, 1995a). Estimated annual costs are $182.5 million for declining cap VOC reductions. Estimated annual costs are $242.4 million for declining cap NO_x reductions.

2.3 SECTION 182(e)(5) PROVISION

The 1990 CAA Amendments added Section 182(e)(5), which applies exclusively to "extreme" ozone nonattainment areas (i.e., only the South Coast ozone nonattainment area). This provision authorizes the State to use conceptual, as yet unadopted, control measures for its attainment demonstration after the year 2000, if these measures anticipate new or improved technology or control techniques and are not needed to meet the rate-of-progress requirements for the first 10 years. The CARB submitted its Section 182(e)(5) rule to EPA for approval as a part of its SIP. The EPA plans to approve CARB's commitment to develop rules under Section 182(e)(5). Because the combination of the FIP measures and CARB's approved 182(e)(5) commitments results in a shortfall, EPA has included a Section 182(e)(5) rule in the FIP committing to developing rules for those source categories which will compliment CARB's 182(e)(5) commitments. Rules for stationary sources will be scheduled for adoption in 2004 and 2005. Rules for mobile sources will be scheduled for adoption in 2001 and 2002.

A cost-effectiveness value of $9,000 per ton of NO_x emissions reduced and $10,000 per ton of VOC emissions reduced were used as estimates of the average cost-effectiveness of emission reductions required under the Section 182(e)(5) rules that will be developed for stationary and mobile sources. The cost-effectiveness values are based on those used to estimate costs for the stationary source declining cap rules because no values exist at this time since the actual costs will be estimated when EPA prepares the rules. A lot of uncertainty surrounds the development of the rules. For example, if CARB submits revisions to its Section 182(e)(5) rule that allow EPA to approve the revisions as part of the SIP, EPA will remove its commitment to develop FIP rules under Section 182(e)(5). In addition, EPA will be tracking emission reductions and improvements in air quality in the South Coast area on an ongoing basis and will be reevaluating the need for developing control measures under Section 182(e)(5). It is possible that emission reductions associated with future rules that may be adopted by CARB or the SCAQMD will alleviate the need for EPA to develop rules for some or all of the source categories identified in the Section 182(e)(5) FIP rule. The EPA will also be tracking technology developments for controlling VOC and NO_x emissions. If it is necessary for EPA to develop rules, it will develop rules for those categories for which technological improvements will provide the most cost-effective emission reductions. In addition, EPA will continue to work with the SCAQMD, the State, and interested parties to investigate the use of innovative strategies such as marketable permits and emissions averaging (e.g., plantwide, manufacturer's bubble) in developing rules under Section 182(e)(5) as mechanisms for minimizing the costs of the rules.

The estimated emission reductions for the Section 182(e)(5) rule in 2010 are 218.0 tpd of VOC and 7.0 tpd of NO_x (Steckel, 1995a). Estimated annual costs are \$795.7 million for Section 182(e)(5) VOC reductions and \$23.0 million for Section 182(e)(5) NO_x reductions.

2.4 ALTERNATIVE COST-EFFECTIVENESS ESTIMATES FOR VOC DECLINING CAP AND SECTION 182(e)(5)

Subsequent to completing the regulatory flexibility and regulatory impact analyses for the declining cap and Section 182(e)(5) rules, an additional analysis was performed to gain perspective on how representative the cost-effectiveness value of \$10,000 per ton may be for the emission reductions required by the VOC declining cap and Section 182(e)(5) rules. The analysis involved developing a total cost curve from the cost-effectiveness and emission reduction values for the control measures shown in Table 2.2.[1] The equation for the curve was then used to project the cost-effectiveness of the additional emission reductions required by these rules. The marginal costs of the emission reductions associated with these rules were estimated in the sequence that the rules will be implemented [i.e., the declining cap rule is scheduled to be implemented before rules developed under Section 182(e)(5)]. In developing the cost curve, daily emissions and costs were used because annual emissions and costs were not available for the SCAQMD's control measures.

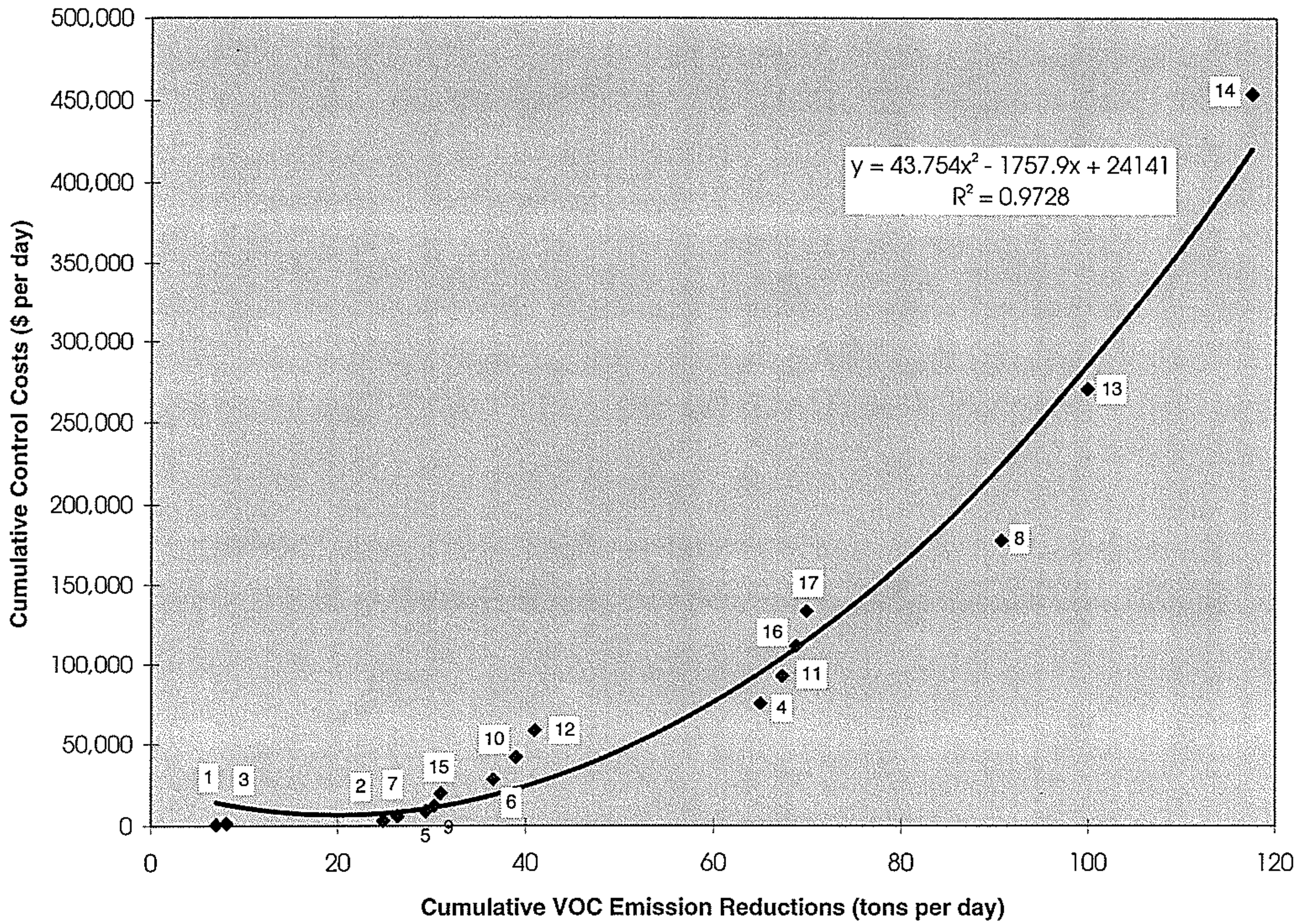
The total cost curve was developed by sorting the control measures in ascending order by their total costs, and then plotting total cumulative costs (dependent variable) by the cumulative emission reductions (independent variable) associated with the control measures. Total costs were estimated by multiplying the cost-effectiveness value by the emission reduction for each control measure. The approach assumes that the control measure with the lowest total cost will be implemented first. This approach was used because it provides a method for weighting the effectiveness of the control measures by their emission reductions.

Figure 2.1 shows the total cumulative cost curve and the equation developed for the curve. The equation has an R^2 of 0.97 and an F-statistic value that is statistically significant for a 99 percent confidence limit. The numbered data labels on the figure correspond to the number associated with each control measure as shown in Table 2.2.

The total cumulative cost of the six FIP measure reductions (42.1 tpd) was estimated using the regression equation. The emission reductions associated with the declining cap rule (50 tpd) were added to the emission reductions associated with the FIP measures to calculate total cumulative costs for the FIP and declining cap rules. The cost-effectiveness of the declining cap rule was calculated by dividing the incremental cost by the incremental reductions estimated for the rule. A similar approach was used to estimate the incremental costs and cost effectiveness associated with emission reductions (218 tpd) estimated for the Section 182(e)(5) rule. The estimated cost-effectiveness of the VOC declining cap emission

[1]It should be noted that the FIP control measure for waste burning was not included in the analysis because there is no cost associated with its emission reductions.

Figure 2.1 Cumulative Control Costs versus Cumulative Emission Reductions



Note: Control measures are ordered by total cost.

reductions is approximately $4,114 per ton, and the cost-effectiveness of the Section 182(e)(5) emission reductions is approximately $15,840 per ton.

Using the alternative cost-effectiveness values, annual costs for the VOC declining cap and Section 182(e)(5) rules are estimated to be $74.8 million and $1.257 billion, respectively. To estimate annual costs, the cost-effectiveness values were rounded to $4,100 and $15,800 per ton for the declining cap and Section 182(e)(5) rules, respectively, and multiplied by the annual emission reductions for each rule. Annual emission reductions were estimated by multiplying daily emission reductions by 365 days per year.

The emission reductions associated with the SCAQMD's command and control measures were not included in the cumulative emission reductions used to calculate incremental cost and cost-effectiveness values for the declining cap and Section 182(e)(5) rules because they would double count the emission reductions required by the declining cap rule. The SCAQMD's measures would require existing SIP measures to be strengthened. The cost-effectiveness and emission reduction values associated with the SCAQMD's command and control measures were used to develop the regression equation because: (1) they are believed to be representative of the cost effectiveness of the types of controls that sources may apply to meet the emission reduction requirements associated with the declining cap and Section 182(e)(5) rules (i.e., they will require incremental reductions from sources that are already subject to SIP measures) and; (2) they were used to increase the number of data points for developing the total cost curve.

CHAPTER 3.0
STATIONARY SOURCE NO_x CONTROL MEASURES FOR THE SACRAMENTO FIP AREA

This chapter presents the NO_x control cost estimates associated with the control measures for stationary sources in the Sacramento FIP area. The source categories for which control measures were developed include the following:

- Stationary gas turbines;
- Reciprocating internal combustion (IC) engines;
- Institutional, commercial, and industrial (ICI) boilers, stream generators, and process heaters;
- Biomass boilers and steam generators; and
- Residential gas-fired water heaters.

All control costs were updated to 1993 dollars using the Chemical Engineering Plant Cost Index (Rafferty, 1993). Table 3.1 summarizes installed capital and annualized costs, emission reductions, and cost effectiveness of the control measures for each source category. The costing methodology for each source category is presented in the final draft document entitled: "Technical Support Document for the Development of Proposed Federal Implementation Plan Rules for Stationary Sources of Nitrogen Oxide Emissions in the Sacramento, California Ozone Nonattainment Area," (Pechan, 1994c). The costs shown in the table do not include costs associated with continuous emissions monitoring or other monitoring requirements specified in the rules. Costs associated with monitoring in addition to the recordkeeping, reporting, and compliance testing requirements of the rules are presented in the information collection request for the rulemaking. Annualized costs include capital recovery costs which were estimated using a 10-year equipment life and 10 percent interest, except where noted in the text below.

Table 3.1 also shows the number of sources and baseline emissions identified in the point and area source inventories that would or would not meet the emission limits of the FIP rule with which the sources would be required to comply. Point source emissions were obtained from the 1990 point source emissions inventory for the Sacramento FIP area. The number of sources identified to be covered by the area source inventory were obtained from permit file information provided by the local air pollution control districts. The number of sources shown under the area source inventory is only a partial count of the total number of sources that are covered by the area source emissions inventory. The total number of area sources is unknown.

Table 3.1

Summary of Installed Capital and Annualized Costs and Cost Effectiveness Associated with NO_x Rules for Stationary Sources in the Sacramento FIP Ozone Nonattainment Area

FIP Rule	1990 Point Source Inventory		1990 Area Source Inventory		Total 1990 Point & Area Source Inventory					
	Number of Sources	NO_x Emissions, TPY	Number of Sources	NO_x Emissions, TPY	Number of Sources	NO_x Emissions, TPY	Installed Capital Costs, 1993 $	Annualized Costs, 1993 $	NO_x Emission Reduction, TPY	Cost Effectiveness, 1993 $/Ton
Biomass Boilers										
Sources subject to FIP rule										
Meets limit	4	267.7	0	0	4	267.7	0	0	0	0
Doesn't meet limit	5	300.9	0	0	5	300.9	1,247,000	320,000	126	2,500
Sources exempt from FIP rule	2	6	0	0	2	6	0	0	0	0
Point source inventory closures	3	38.3	0	0	3	38.3	0	0	0	0
Totals	14	612.9	0	0	14	612.9	1,247,000	320,000	126	2,500
IC Engines										
Sources subject to FIP rule & don't meet limit	3	29	103	900.3	106	929.3	9,025,000	6,071,000	852	7,100
Sources exempt from FIP rule because they operate <200 hr/yr	20	16.9	98 (235)[1]	176.3 NA[2]	118 (235)[1]	193.2 NA	0	0	0	0
Sources <50 bhp exempt from FIP rule	0	0	5	NA	5	NA	0	0	0	0
Diesel engines <125 bhp & <200,000 bhp-hr/yr exempt from FIP rule	0	0	10	11.9	10	11.9	0	0	0	0
Landfill gas engines exempt from FIP rule	0	0	7	35	7	35	0	0	0	0
Point source inventory closures	2	7.2	0	0	2	7.2	0	0	0	0
Totals	25	53.1	224	1,123.5	248	1,176.6	9,025,000	6,071,000	852	7,100

(continued)

Table 3.1 (cont.)

FIP Rule	1990 Point Source Inventory		1990 Area Source Inventory		Total 1990 Point & Area Source Inventory					
	Number of Sources	NO_x Emissions, TPY	Number of Sources	NO_x Emissions, TPY	Number of Sources	NO_x Emissions, TPY	Installed Capital Costs, 1993 $	Annualized Costs, 1993 $	NO_x Emission Reduction, TPY	Cost Effectiveness, 1993 $/Ton
Small Gaseous/Liquid Fuel Fired Boilers (>1 and <5 mmBtu/hr)										
Sources subject to FIP rule & >=1.8 billion Btu/yr										
Meets limit	54	7.4	0	0	54	7.4	0	0	0	0
Doesn't meet limit	12	4.8	14	9.3[3]	26	14.1	607,000	-49,000	8.7	-5,600
Sources subject to FIP rule & >=0.3 & <1.8 billion Btu/yr	15	5.0	3	0.1[3]	18	5.1	15,000	7,000	0.51	13,800
Sources exempt from FIP rule because <1 mmBtu/hr or <0.3 mmBtu/yr	4	0.02	0	0	4	0.02	0	0	0	0
Point source inventory closures	5	8.0	0	0	5	8.0	0	0	0	0
Totals	90	25.2	17	9.4[3]	107	34.6	622,000	-42,000	9.2	-4,600
Large Gaseous/Liquid Fuel Fired Boilers (>5 mmBtu/hr)										
Sources >=9 billion Btu/yr subject to FIP rule & meet limit	33	47.3	0	0	33	47.3	0	0	0	0
Sources >=9 billion Btu/yr subject to FIP rule & don't meet limit	55	334.6	50	70.4[3]	105	405	9,352,500	1,952,500	282.5	6,900
Sources subject to FIP rule & <9 billion Btu/yr	8	16.1	13	2.9[3]	21	19	50,000	17,000	1.9	8,900
Boilers in point source inventory but no information to estimate emission reductions and costs	2	32.5	0	0	2	32.5	0	0	0	0
Point source inventory closures	11	31.1	0	0	11	31.1	0	0	0	0
Boilers in point source inventory replaced by new turbines	9	82.6	0	0	9	82.6	0	0	0	0
Totals	118	554.2	63	73.3[3]	181	617.5	9,402,000	1,969,500	284.4	6,900

(continued)

Table 3.1 (cont.)

FIP Rule	1990 Point Source Inventory		1990 Area Source Inventory		Total 1990 Point & Area Source Inventory					
	Number of Sources	NO_x Emissions, TPY	Number of Sources	NO_x Emissions, TPY	Number of Sources	NO_x Emissions, TPY	Installed Capital Costs, 1993 $	Annualized Costs, 1993 $	NO_x Emission Reduction, TPY	Cost Effectiveness, 1993 $/Ton
Stationary Gas Turbines										
Turbines subject to FIP rule that don't meet limit	1	158.6	1	42.4	2	201	3,001,000	1,581,000	168.3	9,400
Turbines exempt from FIP rule because they operate <200 hr/yr	0	0	6	NA	6	NA	0	0	0	0
Turbines exempt from FIP rule because <0.3 MW	1	5	22	NA	23	5	0	0	0	0
Point source inventory closures	3	23.5	0	0	3	23.5	0	0	0	0
Totals	5	187.1	29	42.4	34	229.5	3,001,000	1,581,000	168.3	9,400
New turbines subject to FIP rule that meet limit	0	0	8	288.3	8	288.3	0	0	0	0
Residential Water Heaters	0	0	4	970.9	0	970.9	0	0	204.40	0
Totals:	252	1,422.5	344	2,507.8	596	3,930.4	23,297,500	9,899,500	1,644.3	6,000

[1] A total of 235 IC engines were identified in the Sacramento Metropolitan Air Quality Management District's (SMAQMD) permit data base that are covered by the area source inventory. However, no emissions information was available for these engines. The horsepower ratings for several of the engines was not available; therefore, some of the engines may be exempt from all of the requirements of the FIP rule if they are rated at <50 horsepower.

[2] NA = not available.

[3] 1992 emissions obtained from the SMAQMD.

For IC engines covered by the area source emissions inventory for which costs were estimated, emissions were estimated based on allowable operating times because actual operating times were not available. Consequently, the emission reduction values may be lower and cost effectiveness values may be higher if baseline emissions for the engines were estimated using actual operating times. All of the small and large boilers covered by the area source inventory are in Sacramento County. The Sacramento Metropolitan Air Quality Management District (SMAQMD) provided actual emissions for 1992 for these boilers, and this information was used to estimate baseline emission, emission reduction, and cost effectiveness values.

Costs were not estimated for sources that would currently meet the FIP rule limit. In addition, costs were not estimated for sources in the point source inventory that were identified as being closed through contacts with the local air pollution control districts. The remainder of this section explains the basis for the control cost estimates associated with each rule.

3.1 STATIONARY GAS TURBINES

Units with a rated heat output ≥0.3 megawatt (MW) would be subject to the rule. Owners or operators of units with a rated heat output capacity ≥0.3 and <2.9 MW will be subject to a NO_x reference limit of 25 parts per million (ppm). Owners or operators of units with a rated heat output capacity ≥2.9 MW will be subject to a NO_x reference limit of 9 ppm limit if they use selective catalytic reduction (SCR), or 15 ppm if they use controls other than SCR (e.g., low-NO_x combustors) to comply. The NO_x reference limit is corrected for the efficiency of a turbine if a turbine's efficiency is >25 percent. The NO_x limit is also corrected to 15 percent stack gas oxygen by volume on a dry basis.

Only two existing turbines will have to install controls to meet the ppm limit of the FIP rule. Both turbines have a rated heat output >2.9 MW; therefore, the owners or operators of the turbines must either meet a reference limit of 15 or 9 ppm depending on the controls used to comply with the rule. The control cost analysis only evaluated the costs of using SCR to comply with the 9 ppm limit. Consequently, control costs would be overestimated if the owners or operators of the turbines use controls other than SCR to meet the 15 ppm limit. The control costs presented for the one unit are based on the use of a new water injection system and SCR. The efficiency of the two control techniques combined was estimated at 85 percent. The control costs for the second unit are based on the use of SCR with a control efficiency of 79 percent.

According to the SMAQMD, eight new turbines will be installed in Sacramento County by 1995. The units are being installed by Procter & Gamble, SEPCO, Carson Ice, and Campbell Soup to replace nine boilers that are currently in the point source emissions inventory. All of the new turbines are being required by the SMAQMD to meet a 5 ppm limit. It was assumed that the control costs associated with the FIP rule would be zero for these units because they will be constructed before they must comply with the emission limits of the FIP rule.

Owners or operators of peaking and emergency standby units with an operating time <200 hours per year will be exempt from the ppm limit of the FIP rule, but will be required to monitor the operating time of each unit to demonstrate that it will be exempt from the ppm limit. Owners or operators will probably install an instrument on each engine to record total annual elapsed operating time. However, information was not available to estimate the cost of an elapsed operating time meter.

3.2 RECIPROCATING INTERNAL COMBUSTION ENGINES

Units rated at ≥50 brake horsepower (bhp) will be subject to a ppm limit if they are operated ≥200 hours per year. The NO_x limits for diesel, rich-burn, and lean-burn engines are 80 ppm, 25 ppm, and 45 ppm, respectively. The limits are corrected to 15 percent stack gas oxygen by volume on a dry basis, and are corrected for the efficiency of an engine if an engine's efficiency is >30 percent. Owners or operators have the option of complying with a control efficiency limit if they cannot meet a ppm limit. The control efficiency limits for diesel, rich-burn, and lean-burn engines are 90 percent, 96 percent, and 94 percent, respectively. Owners or operators that do not have to retrofit existing units to comply must demonstrate compliance by May 15, 1996. Owners or operators that have to retrofit existing units with combustion controls or new control equipment have until December 31, 1997 to comply. However, the rule contains two options which will allow owners or operators to extend the date by which they will be required to comply with the rule. One option will allow owners or operators to decrease the operating time of an engine to <200 hours per calendar year by May 15, 1999, so long as they meet the increments of progress specified in the rule. The other option will allow owners or operators to extend the date of compliance with the rule to May 15, 1999, if they choose to convert an engine to electric power. Because of a lack of information on how many engines will be converted to electric power or will have their operating time decreased to <200 hours per year, costs were not estimated for these two control options. It was assumed that all of the engines included in the analysis of emission reductions and costs will use add-on controls or combustion modifications to comply with the rule.

Control costs for diesel engines are based on the use of SCR. Selective catalytic reduction was assumed to achieve a 90 percent emission reduction. Except for five engines that were identified as being of the lean-burn type, control costs for natural gas and gasoline powered engines are based on the use of nonselective catalytic reduction (NSCR). Nonselective catalytic reduction was assumed to achieve a 90 percent emission reduction. Except for two engines that were identified as being of the rich-burn type, the engine type for the remaining engines was assumed to be rich-burn. If any of the engines are of the lean-burn type, it would have been necessary to apply SCR to estimate control costs, which would be much higher than the cost of NSCR. For the five lean-burn engines, baseline emission information was obtained from the local air pollution control district that indicated that the engines could achieve the ppm limits of the rule using air/fuel adjustment techniques. Therefore, the costs for the five engines were based on the use of air/fuel adjustment techniques which were assumed to achieve a 20 percent emission reduction. Control cost, emission reduction, and cost effectiveness values for each diesel, natural gas, and gasoline powered engine are presented in Tables 7-4 and 7-5 of the TSD for the development of NO_x rules for the Sacramento FIP area (Pechan, 1994c).

Owners or operators of engines rated at ≥50 bhp and operated <200 hours per year, and diesel engines ≥125 bhp and operated <200,000 bhp hours per year, would be exempt from the ppm limit of the FIP rule, but would be required to monitor the operating time of each unit to demonstrate that it would be exempt from the ppm limit. Owners or operators would probably install an instrument on each engine to record total annual elapsed operating time. However, information was not available to estimate the cost of an elapsed operating time meter.

3.3 ICI BOILERS, STREAM GENERATORS, AND PROCESS HEATERS

3.3.1 Large Units

Large boilers, steam generators, and process heaters are units that have a rated heat input ≥5 million British thermal units per hour (mmBtu/hr). Units with an annual heat input $\geq 9 \times 10^9$ British thermal units per year (Btu/yr) must meet a 30 ppm limit. The limit is corrected to 3 percent stack gas oxygen by volume on a dry basis. Control costs for large boilers with an annual heat input $\geq 9 \times 10^9$ Btu/yr are based on the use of low-NO_x burners (LNB) and/or flue gas recirculation (FGR). LNB was assumed to achieve a 50 percent emission reduction. Costs for boilers needing >50 percent reduction in baseline emissions to achieve a 30 ppm limit are based on the use of LNB/FGR combined. It was assumed that all boilers needing >50 percent reduction would be able to retrofit with LNB/FGR to achieve a 30 ppm limit. Emission reductions were calculated using the difference between a boiler's baseline emission rate and 30 ppm. In reality, there may be some boilers that would have to install SCR to achieve a 30 ppm limit. However, information on the age, type, and combustion characteristics of the boilers was not available which prohibited a more detailed engineering analysis of control options.

Owners or operators of large boilers with an annual heat input $<9 \times 10^9$ Btu/yr would be required to maintain records on fuel consumption to demonstrate that each unit would be exempt from the ppm limit. Owners or operators would probably install a totalizing fuel meter on each unit to record total annual fuel consumption. However, information was not available to estimate the cost of a totalizing fuel meter.

3.3.2 Small Units

Small boilers, steam generators, and process heaters are units that have a rated heat input ≥1 and <5 mmBtu/hr. Units with an annual heat input $\geq 1.8 \times 10^9$ Btu/yr must meet a 30 ppm limit. The limit is corrected to 3 percent stack gas oxygen by volume on a dry basis. Control costs for small boilers with an annual heat input ≥1.8 x 10^9 Btu/yr are based on the use of forced-draft LNB. A 10 percent fuel savings was included in the calculation of annualized costs which resulted in an overall cost savings for the boilers analyzed. It was assumed that all of the boilers could be retrofitted with LNB to achieve a 30 ppm limit. Emission reductions were calculated using the difference between a boiler's baseline emission rate and 30 ppm. In reality, there may be some boilers that would have to install FGR to achieve a 30 ppm limit. However, information on the age, type, and combustion characteristics of the boilers was not available which prohibited a more detailed engineering analysis of control options.

Owners or operators of small boilers with an annual heat input ≥0.3 and <1.8 x 10^9 Btu/yr would be required to maintain records on fuel consumption to demonstrate that each unit would be exempt from the ppm limit. Owners or operators of small boilers with an annual heat input <0.3 x 10^9 Btu/yr would be required to maintain records to demonstrate that each unit would be exempt from the boiler tuneup or oxygen monitoring requirements. Owners or operators would probably install a totalizing fuel meter on each unit to record total annual fuel consumption. However, information was not available to estimate the cost of a totalizing fuel meter.

3.3.3 Cost of Boiler Tuneups

Owners or operators of large boilers with an annual heat input <9 x 10^9 Btu/yr, and owners or operators of small boilers with an annual heat input ≥0.3 and <1.8 x 10^9 Btu/yr, would be required to either tune each unit twice per year or monitor stack gas oxygen concentrations with an O_2 monitor or an oxygen trim system. The cost of boiler tuneups was used to estimate the control costs associated with this requirement.

The capital investment associated with boiler tuneups is the cost of an analyzer to measure NO_x, CO, and O_2. The average cost of an analyzer was estimated at $5,000. The annualized capital cost of an analyzer was estimated at $1,320 based on a 5-year equipment life and 10 percent interest. It was assumed that each plant would purchase one analyzer. There are 10 plants with a total of 21 large boilers and 3 plants with a total of 18 small boilers that would be subject to the boiler tuneup requirement. Therefore, total capital costs were estimated by multiplying the number of plants by $5,000. Annualized costs were estimated by adding the labor cost associated with performing a boiler tuneup twice per year to the annualized capital recovery cost of an analyzer. The annual labor cost for a boiler tuneup twice per year was estimated at $180. Total annual labor costs per plant were estimated by multiplying $180 by the number of boilers at a plant.

A boiler tuneup was assumed to achieve a 10 percent emission reduction in baseline emissions. There may be a fuel savings associated with boiler tuneups; however, no information was available to estimate fuel savings. Many of the boilers for which boiler tuneup costs were estimated had very low baseline emissions. Consequently, the emission reductions associated with boiler tuneups were low which resulted in high cost-effectiveness values relative to the cost effectiveness of controls for boilers subject to the ppm limits of the small and large boiler rules.

3.4 BIOMASS BOILERS AND STEAM GENERATORS

Biomass boilers that have a rated heat input ≥5 mmBtu/hr and an annual heat input ≥9 x 10^9 Btu/yr would be required to either meet a 70 ppm limit or reduce uncontrolled emissions by 50 percent. Control costs for biomass boilers are based on the use of selective noncatalytic reduction (SNCR). The limit is corrected to 12 percent stack gas carbon dioxide by volume on a dry basis.

3.5 RESIDENTIAL GAS-FIRED WATER HEATERS

The FIP rule for residential gas-fired water heaters applies to units with a heat output rating <75,000 Btu/hr. The rule would prohibit the sale, supply, or distribution of units in the Sacramento FIP area after May 15, 1996, unless the units meet a 40 nanogram per joule NO_x limit. Low-NO_x water heaters are currently being sold in the Sacramento FIP area that meet the limit of the rule. The cost of low-NO_x water heaters is the same or slightly less than the cost of conventional units. Therefore, the cost associated with the rule was assumed to be zero.

CHAPTER 4.0
RULE EFFECTIVENESS-ADJUSTED EMISSION REDUCTIONS FOR STATIONARY SOURCE CONTROL MEASURES

This chapter presents the rule effectiveness-adjusted emission reduction estimates for the stationary source control measures. Rule effectiveness (RE) reflects the ability of a regulatory program to achieve all the emission reductions that could have been achieved by full compliance with the appropriate regulations at all sources at all times. Experience has demonstrated that regulatory programs are typically less than 100 percent effective in achieving their expected emission reductions. There are at least four general factors that influence RE:

- the nature of the regulation;
- the nature of techniques used to comply with the regulation;
- the performance of sources in complying with the regulation; and
- the peformance of the implementing agency in enforcing the regulation.

The EPA has proposed a policy that a baseline assumption of 80 percent RE should be applied to all regulated source categories. This 80 pecent default value was initially based on a survey of several States that estimated the actual effectiveness of their emission control regulations.

Table 4.1 presents the RE-adjusted stationary source emission reductions for each of the FIP control measures. These estimates are developed for purposes of the FIP attainment demonstrations. Table 2.1, in contrast, displays the pre-RE adjusted emission reduction estimates. These estimates are multiplied by the appropriate cost-effectiveness estimate for each control measure because these cost-effectiveness estimates do not take into account the effect of RE on emission reductions.

Table 4.1
Summary of Rule Effectiveness-Adjusted Stationary Source Emission Reductions

SACRAMENTO Control Measure	VOC Reduction[1] (tpd) 2005	NO_x Reduction[1] (tpd) 2005
Wood Products	0.3	
Auto Refinishing Operations	3.3	
Adhesives & Sealants	1.2	
Solid Waste Landfills	1.1	
Solvent Cleaning Operations	3.9	
Commercial Bakeries[2]	0.5	
Fugitive Emissions		
Refineries, Bulk Plants/Terminals, & Chemical Plants	0.2	
Pesticides	2.6	
Architectural Coatings	3.4	
Gasoline Transfer and Dispensing	0.3	
Aerosol Coating Products	0.9	
Formica[2]	0.3	
SierraPine	0.3	
Sierra-Pacific[3]	0.5	
Reynolds Metal	0.1	
Residential Water Heaters		0.5
IC Engines		0.4
Gas Turbines		0.2
Biomass Boilers		0.3
Large Boilers		0.6
Small Boilers		0.0
Total	19.0	1.9

[1] Totals may not equal sums due to rounding.
[2] This measure has recently been approved as part of the SIP. It is presented here so that the measure's emission reductions are appropriately credited.
[3] This source was formerly known as Michigan-California Lumber in the proposed rule (before acquisition by Sierra-Pacific Industries).

Table 4.1. Summary of Rule Effectiveness-Adjusted Stationary Source Emission Reductions (cont.)

VENTURA Control Measure	VOC Reduction[1] (tpd) 2005
Wood Products Coatings	0.2
Solvent Cleaning Operations	1.8
Waste Burning	0.1
Fugitive Emissions	
1. Refineries, Bulk Plants/Terminals, & Chemical Plants	0.1
2. Oil Production Facilities	1.1
Pesticides	3.1
Architectural Coatings	1.1
Gasoline Transfer and Dispensing	0.1
Aerosol Coating Products	0.3
Total	8.0

SOUTH COAST Control Measure	NO_x Reduction[1] (tpd) 2010	VOC Reduction[1] (tpd) 2010
Waste Burning		0.2
Fugitive Emissions		
1. Refineries, Bulk Plants/Terminals, & Chemical Plants		2.4-3.6
2. Oil Production Facilities		0.7
Pesticides		1.8
Architectural Coatings		16.6
Gasoline Transfer and Dispensing		5.6
Aerosol Coating Products		7.4
Declining Cap	73.8	40.0
Section 182(e)(5)	7.0	218.0
Total	80.8	292.8-294.0

[1] Totals may not equal sums due to rounding.

Table 4.1. Summary of Rule Effectiveness-Adjusted Stationary Source Emission Reductions (cont.)

STATEWIDE[1]	**VOC Reduction**[2] **(tpd)**	
Control Measure	**2005**	**2010**
Pesticides	22.4	22.4
Architectural Coatings	57.6	61.6
Aerosol Coating Products	12.0	20.0
Total	92.0	104.0

[1] Statewide emissions reductions should not be totaled with FIP area numbers because the statewide estimates for these control measures include the emission reductions shown for each FIP area.

[2] Totals may not equal sums due to rounding.

CHAPTER 5.0
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